

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

## LISTING OF CLAIMS

What is claimed is:

1. (original) An electronic watermarking system, for embedding additive information in digital data, for which one frame is defined as including N samples extracted from digital data and a current frame is defined as a frame that is overlapped by M samples ( $0 < M \leq N/2$ ) of a preceding frame, comprising:

(1) a frequency domain transformation unit, for multiplying a frame extracted from digital data by a window function, and for using the results to perform a Fourier transform and thus obtain a frequency component for said digital data;

(2) a frequency domain embedding unit, for employing bit information for additive information, and a frequency band for said frequency component to change the amplitude of said frequency component in said digital data obtained by said frequency domain transformation unit;

(3) a time domain transformation unit, for performing an inverse Fourier transform to return, to a time domain signal, said frequency component whose amplitude has been changed by said frequency domain embedding unit; and

(4) an additive information embedding frame generator, for multiplying, by a window function, said time domain signal obtained by said time domain transformation unit, and for superimposing overlapped frames to generate a frame wherein said additive information is embedded.

2. (original) An electronic watermarking system according to claim 1, wherein, to change said amplitude of said frequency component of said digital data, said frequency domain embedding unit (2) employs bit information for additive information and the values of a mask, determined in advance in accordance with a frequency band, with which said frequency component is to be increased or decreased.

3. (original) An electronic watermarking system according to claim 2, wherein the values of said mask corresponding to all the frequencies included in one frequency band are equalized.

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1 4. (original) An electronic watermarking system according to claim 2 or 3, wherein, as the  
2 frequency increases, the width of said frequency band is extended.

3 5. (withdrawn) An electronic watermark detection system, for detecting additive information  
4 embedded in digital data, comprising:

5 (1) a frequency domain transformation unit, for multiplying a frame extracted from  
6 digital data by a window function, and for performing a Fourier transform to obtain a frequency  
7 component from said digital data;

8 (2) an amplitude storing unit, for obtaining amplitudes for said frequency components  
9 acquired by said frequency domain transformation unit, and for storing a number of said  
10 amplitudes that equals a predetermined frame count;

11 (3) a cycle synchronization unit, for employing an amplitude value stored by said  
12 amplitude storing unit to designate a bit detection start frame; and

13 (4) a bit detector, for detecting bit information from embedded additive information  
14 beginning at said bit detection start frame obtained by said cycle synchronization unit.

15 6. (withdrawn) An electronic watermark detection system according to claim 5, wherein said  
16 frequency domain transformation unit (1) uses the shorter length of said frame than the length  
17 when said additive information is embedded.

18 7. (withdrawn) An electronic watermark detection system according to claim 5, wherein, in  
19 order to designate said bit detection start frame by referring to said amplitude values, said cycle  
20 synchronization unit (3) employs calculation results obtained by using the values of a mask that  
21 defines, in advance, a frequency component increase or decrease.

22 8. (original) An electronic watermarking method, for embedding additive information in digital  
23 data, whereby one frame is defined as including N samples extracted from digital data, and a  
24 current frame is defined as a frame that is overlapped by M samples ( $0 < M \leq N/2$ ) of a preceding  
25 frame, comprising the steps of:

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1 (1) extracting one frame as a current frame from digital data;  
2 (2) multiplying said current frame by a window function;  
3 (3) performing a Fourier transform for the resultant current frame to obtain a frequency  
4 component for said current frame;  
5 (4) changing an amplitude of said frequency component in accordance with bit  
6 information for additive information;  
7 (5) performing an inverse Fourier transform for the resultant frequency component;  
8 (6) multiplying, by said window function, said frequency component obtained using said  
9 inverse Fourier transform; and  
10 (7) adding an (N-M)-th sample, from the end of a preceding frame processed in the  
11 same manner as said steps (1) to (6), to an M-th sample, from the head of said current frame  
12 processed at said step (6), and generating one new frame including N samples.

13 9. (original) An electronic watermarking method according to claim 8, wherein, at said step (4)  
14 of changing said amplitude of said frequency component, said amplitude is changed by  
15 employing bit information for additive information and the values of a mask, determined in  
16 advance in accordance with a frequency band, with which said frequency component is to be  
17 increased or decreased.

18 10. (original) An electronic watermarking method according to claim 9, wherein the values of  
19 said mask corresponding to all the frequencies included in one frequency band are equalized.

20 11. (original) An electronic watermarking method according to claim 9 or 10, wherein, as the  
21 frequency increases, the width of said frequency band is extended.

22 12. (withdrawn) A method for detecting additive information embedded in digital data  
23 comprising the steps of:

- 24 (1) extracting one frame including N samples from digital data;  
25 (2) multiplying said frame by a predetermined window function;

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- 1 (3) performing a Fourier transform for said resultant frame to obtain a frequency  
2 component of said frame;  
3 (4) storing a value for an amplitude of said frequency component;  
4 (5) calculating an optimal start frame for additive information detection when the stored  
5 amplitude value reaches a predetermined value through said steps (1) to (4); and  
6 (6) detecting bit information for said additive information beginning at said start frame.

7 13. (withdrawn) A method according to claim 12, wherein, at said step (1) of extracting one  
8 frame, uses the shorter length of said frame than the length when said additive information is  
9 embedded.

10 14. (withdrawn) A method according to claim 12, wherein, at said step (5) of calculating the  
11 optimal start frame, calculation results obtained by using the values of a mask, which define, in  
12 advance, a frequency component increase or decrease, are employed in order to designate said  
13 bit detection start frame by referring to said amplitude value.

14 15. (withdrawn) An electronic watermarking method for embedding in digital data  $N$  bits ( $N \geq$   
15 1) of additive information comprising the steps of:

- 16 (1) reading sample values, from digital data, up to an  $R$ -th sample ( $R \geq 1$ );  
17 (2) reading sample values, from said digital data, following an  $(R+1)$ -th sample;  
18 (3) changing said sample values following said  $(R+1)$ -th sample in accordance with bit  
19 information for additive information; and  
20 (4) adding together the values up to said  $R$ -th sample in said digital data and the values  
21 following said  $(R+1)$ -th sample, changed in accordance with said bit information for said  
22 additive information.

23 16. (withdrawn) An electronic watermarking method for embedding in digital data  $N$  bits ( $N \geq$   
24 1) of additive information comprising the steps of:

- 25 (1) reading a sample value from digital data;

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(2) starting to change said sample value in accordance with bit information for additive information, excluding a head bit of said additive information; and

(3) using said changed sample value to generate new digital data.

17. (withdrawn) An electronic watermarking method for embedding in digital data  $N$  bits ( $N \geq 1$ ) of additive information comprising the steps of:

(1) reading a sample value from digital data;

(2) changing said sample value in accordance with bit information for additive information;

(3) adding noise at random to said changed sample value; and

(4) using said changed sample value to generate new digital data.

18. (withdrawn) An electronic watermarking method for embedding in digital data  $N$  bits ( $N \geq 1$ ) of additive information comprising the steps of:

(1) reading a sample value from digital data;

(2) changing said sample value in accordance with bit information for additive information, and setting at random a case wherein a change is not required; and

(3) using either the changed sample value or the unchanged sample value to generate new digital data.

19. (withdrawn) An electronic watermarking method for embedding in digital data  $N$  bits ( $N \geq 1$ ) of additive information comprising the steps of:

(1) changing digital data by superimposing, inserting, deleting or shifting a specific sample of said digital data;

(2) reading a sample value from said digital data;

(3) changing said sample value in accordance with bit information for additive information; and

(4) using said changed sample value to generate new digital data.

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1 20. (withdrawn) An electronic watermarking method for embedding in digital data  $N$  bits ( $N \geq$

2 1) of additive information comprising the steps of:

3 (1) expanding or compressing digital data along a time axis;

4 (2) reading a sample value from said digital data;

5 (3) changing said sample value in accordance with bit information for additive  
6 information; and

7 (4) using said changed sample value to generate new digital data.

8 21. (withdrawn) An electronic watermarking method for embedding in digital data  $N$  bits ( $N \geq$

9 1) of additive information comprising the steps of:

10 (1) reading a sample value from said digital data;

11 (2) changing said sample value in accordance with bit information for additive  
12 information;

13 (3) using said changed sample value to generate new digital data; and

14 (4) expanding or compressing said new digital data along a time axis.

15 22. (withdrawn) An electronic watermarking method according to claim 20 or 21, wherein an  
16 expansion/compression rate for the digital data does not exceed 1%.

17 23. (withdrawn) An electronic watermarking method for embedding in digital data  $N$  bits ( $N \geq$

18 1) of additive information comprising the steps of:

19 (1) re-sampling digital data at a sampling frequency  $r'$  and reading a sample value from  
20 said digital data;

21 (2) changing said sample value in accordance with bit information for additive  
22 information; and

23 (3) sampling said changed sample value at the original sampling frequency  $r$  to generate  
24 new digital data.

25 24. (withdrawn) An electronic watermarking method for embedding in digital data  $N$  bits

26 ( $N \geq 1$ ) of additive information comprising the steps of:

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1 (1) sampling digital data at a sampling frequency  $r'$  and reading a sample value from said  
2 digital data;

3 (2) obtaining a change in said sample value in accordance with bit information for  
4 additive information;

5 (3) re-sampling said change at a sampling frequency  $r$  for the original digital data; and

6 (4) adding said re-sampled change to said original digital data to generate new digital  
7 data.

8 25. (original) A computer-readable recording medium on which a program for embedding  
9 additive information in digital data is stored, said program defining one frame as including  $N$   
10 samples extracted from digital data and defining a current frame as a frame that is overlapped  
11 by  $M$  samples ( $0 < M \leq N/2$ ) of a preceding frame, and permitting a computer to execute:

12 (1) a frequency domain transformation function, for multiplying a frame extracted from  
13 digital data by a window function, and for using the results to perform a Fourier transform and  
14 thus obtain a frequency component for said digital data;

15 (2) a frequency domain embedding function, for employing bit information for additive  
16 information, and a frequency band for said frequency component to change the amplitude of  
17 said frequency component in said digital data obtained by said frequency domain transformation  
18 function;

19 (3) a time domain transformation function, for performing an inverse Fourier transform  
20 to return, to a time domain signal, said frequency component whose amplitude has been  
21 changed by said frequency domain embedding function; and

22 (4) an additive information embedding frame generation function, for multiplying, by a  
23 window function, said time domain signal obtained by said time domain transformation  
24 function, and for superimposing overlapped frames to generate a frame wherein said additive  
25 information is embedded.

26 26. (withdrawn) A computer-readable recording medium on which a program for detecting  
27 additive information embedded in digital data is stored, said program permitting a computer to  
28 execute:

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1 (1) a frequency domain transformation function, for multiplying a frame extracted from  
2 digital data by a window function, and for performing a Fourier transform to obtain a frequency  
3 component from said digital data;

4 (2) an amplitude storing function, for obtaining amplitudes for said frequency  
5 components acquired by said frequency domain transformation function, and for storing a  
6 number of said amplitudes that equals a predetermined frame count;

7 (3) a cycle synchronization function, for employing an amplitude value stored by said  
8 amplitude storing function to designate a bit detection start frame; and

9 (4) a bit detection function, for detecting bit information from embedded additive  
10 information beginning at said bit detection start frame obtained by said cycle synchronization  
11 function.

12 27. (withdrawn) An article of manufacture comprising a computer usable medium having  
13 computer readable program code means embodied therein for causing detection of additive  
14 information embedded into digital data, the computer readable program code means in said  
15 article of manufacture comprising computer readable program code means for causing a computer  
16 to effect the steps of claim 12.

17 28. (original) An electronic watermarking system for embedding additive information into  
18 digital data, said system comprising:

19  
20 a frequency domain transformation unit for multiplying a current frame extracted from  
21 said digital data by a window function, and for using the results of the multiplication to obtain a  
22 frequency component for said digital data, wherein a frame in said system is defined as  
23 including a plurality of samples extracted from the digital data, and a current frame in said  
24 system is defined as a frame that is overlapped by at least one sample from said plurality of  
25 samples of a preceding frame;

26 a frequency domain embedding unit for employing bit information for additive  
27 information, and for employing a frequency band for said frequency component in changing the



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1 amplitude of said frequency component in said digital data obtained by said frequency domain  
2 transformation unit;

3 a time domain transformation unit for performing an inverse transform to return said  
4 frequency component whose amplitude has been changed by said frequency domain embedding  
5 unit to a time domain signal; and

6 an additive information embedding frame generator for multiplying said time domain  
7 signal obtained by said time domain transformation unit by the window function, and for  
8 superimposing overlapped frames to generate a frame wherein said additive information is  
9 embedded.

10 29. (original) An electronic watermarking system according to claim 1, wherein in changing  
11 said amplitude of said frequency component of said digital data, said frequency domain  
12 embedding unit employs bit information for additive information and the values of a mask  
13 determined in advance in accordance with a frequency band.

14 30. (original) An electronic watermarking system according to claim 29, wherein the values of  
15 said mask corresponding to frequencies included in one frequency band are equalized.

16 31. (withdrawn) An electronic watermark detection system comprising:

17 a frequency domain transformation unit for multiplying a frame extracted from digital  
18 data by a window function, and for performing a transform to obtain a frequency component  
19 from said digital data, said system for detecting additive information embedded in the digital  
20 data;

21 (2) an amplitude storing unit for obtaining amplitudes for said frequency components  
22 acquired by said frequency domain transformation unit, and for storing a number of said  
23 amplitudes that equals a predetermined frame count;

24 (3) a cycle synchronization unit for employing an amplitude value stored by said  
25 amplitude storing unit to designate a bit detection start frame; and

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1 (4) a bit detector, for detecting bit information from embedded additive information  
2 beginning at said bit detection start frame obtained by said cycle synchronization unit.

3 32. (withdrawn) An electronic watermark detection system according to claim 31, wherein said  
4 frequency domain transformation unit (1) uses the shorter length of said frame than the length  
5 when said additive information is embedded.

6 33. (original) An electronic watermarking method for embedding additive information into  
7 digital data, said method comprising:

8 defining a frame as including a plurality of samples extracted from the digital data;

9 defining a current frame as a frame that is overlapped by at least one of said plurality of  
10 samples of a preceding frame;

11 extracting one frame as a current frame from digital data;  
12 multiplying said current frame by a window function;  
13 performing a transform for the resultant current frame to obtain a frequency component  
14 for said current frame;

15 changing an amplitude of said frequency component in accordance with bit information  
16 for additive information;

17 performing an inverse transform for the resultant frequency component;  
18 multiplying, by said window function, said frequency component obtained using said  
19 inverse transform;

20 adding an additional sample, from the end of a preceding frame processed in the same  
21 manner as in said steps of extracting, multiplying, performing, changing, performing and  
22 multiplying to a previous sample from the head of said current frame processed at said step of  
23 multiplying, and;

24 generating one new frame including the plurality of samples.

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1 34. (original) An article of manufacture comprising a computer usable medium having computer  
2 readable program code means embodied therein for causing additive information to be embedded  
3 into digital data, the computer readable program code means in said article of manufacture  
4 comprising computer readable program code means for causing a computer to effect the steps of  
5 claim 33.

6 35. (withdrawn) A method for detecting additive information embedded in digital data  
7 comprising the steps of:  
8 extracting one frame including a plurality of samples from the digital data;  
9 multiplying said one frame by a predetermined window function to obtain a resultant  
10 frame;  
11 performing a transform for said resultant frame to obtain a frequency component of said  
12 resultant frame;  
13 storing a value for an amplitude of said frequency component;  
14 calculating an optimal start frame for additive information detection when the stored  
15 amplitude value reaches a predetermined value through said steps of extracting, multiplying,  
16 performing and storing; and  
17 detecting bit information for said additive information beginning at said start frame.

18 36. (withdrawn) An article of manufacture comprising a computer usable medium having  
19 computer readable program code means embodied therein for causing additive information to be  
20 embedded into digital data, the computer readable program code means in said article of  
21 manufacture comprising computer readable program code means for causing a computer to effect  
22 the steps of claim 35.

23 37. (original) An article of manufacture comprising a computer usable medium having computer  
24 readable program code means embodied therein for causing additive information to be embedded  
25 into digital data, the computer readable program code means in said article of manufacture  
26 comprising computer readable program code means for causing a computer to effect the steps of  
27 claim 8.

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1 38. (original) A computer program product comprising a computer usable medium having  
2 computer readable program code means embodied therein for causing additive information to be  
3 embedded into digital data, the computer readable program code means in said computer  
4 program product comprising computer readable program code means for causing a computer to  
5 effect the functions of the system in claim 1.

6 39. (withdrawn) A computer program product comprising a computer usable medium having  
7 computer readable program code means embodied therein for causing detection of additive  
8 information embedded into digital data, the computer readable program code means in said  
9 computer program product comprising computer readable program code means for causing a  
10 computer to effect the functions of the system in claim 5.